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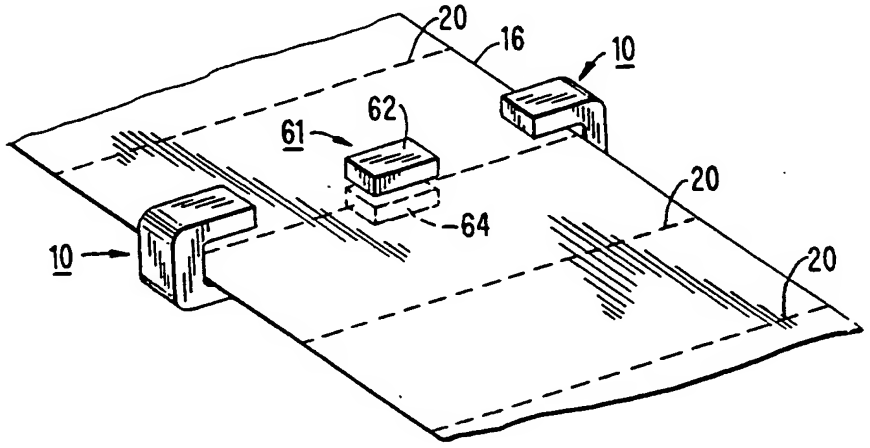

(57) Abstract

The perforation detector (10) beams high-intensity infra-red radiation at the perforations (20) and detects the radiation transmitted either through the perforation holes (20), or through the material in which the perforations (20) are formed, if the holes (20) are imperfect and do not extend all the way through the material. The infra-red radiation is generated by an infra-red diode (126) which is driven with high-frequency electrical pulses which are pulse-width modulated to give maximum radiation intensity without damaging the diode. The detector (10) is particularly valuable in detecting lines of perforations (20) in panels of tickets (16) which are to be torn apart along the perforation lines (20), and particularly in panels of instant-winner lottery tickets (16). A dispenser (30) for such tickets (16) is provided in which the detector (10) is used to detect the perforation lines (20) and control the operation of a guillotine-type ticket - separation device (92, 94). The dispenser (30) has a simple, compact separation mechanism which will separate tickets (16) from a plurality of sources with a single stroke.

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PERFORATION DETECTION AND TICKET DISPENSING DEVICE AND METHOD

This invention relates to perforation detection devices and methods, and in particular relates to the detection of a line of perforations in a web of material to faciliate the separation of articles such as tickets from one another. This invention also relates to ticket dispensers using such perforation detection devices and methods to separate and dispense tickets from panels of tickets which are delineated from one another by perforation lines.

The web preferably has lines of perforations extending across it and defining lengths of material which can be manually or mechanically separated along each line of perforation. Examples of such webs are tractor-feed computer paper, continuous stationary, stamps, and lottery tickets. The web may be of any material, and it may be unwound from a roll, from a concertina stack, from a fan-folded array, or from some other storage arrangement.

The perforation detector is particularly useful in detecting perforations delineating tickets from one another in ticket panels, and particularly lottery ticket panels, where the perforations often are poorly formed and do not extend all the way through the web.

Tickets to be dispensed from such machines include transportation tickets and lottery tickets - particularly the "instant winner" types of lottery tickets in which the tickets are relatively thick and difficult to perforate.

In the past, various light sources and photo detectors have been proposed for use in perforation detection. Specifically, both ordinary LEDs and LEDs producing monochromatic light have been proposed for this purpose. However, it is believed that such proposals have enjoyed little success in detecting the perforations such as those used in panels of lottery tickets and other

objects in which the perforations often form incomplete holes. This, an accurate and reliable perforation detector for such uses is needed.

Ticket vending machines for tickets fastened together either require the customer to tear off the tickets purchased, or else the machines must provide some means for separating the tickets from one another along perforation lines. The separator means often is complex and expensive; especially in vending machines for vending several different types of tickets from different outlets. Thus, there is an increased need for simplicity and economy in the construction of such separator means.

It is an object of this invention to provide an improved perforation detection system and method; one which will alleviate the foregoing problems.

It also is an object of the invention to provide a simple, compact and economical ticket dispenser and vending machine utilizing the improved perforation detection provided by the invention.

It is a further object to provide such a vending machine which is compact, simple and inexpensive.

These objects are met by the provision of a method and apparatus for detecting perforations in a web of material using high-frequency electromagnetic radiation.

Preferably, use is made of infra-red radiation. It is beamed at the perforations and the radiation is detected by a detector, as modified by the perforations.

Preferably, the radiation is applied on one side of the web and the detector is located on the other side to detect the radiation which passes through the perforations.

The preferred infra-red source is one or more infra-red emitting diodes. Each diode is energized by high-frequency electrical pulses. The frequency of the pulses used preferably corresponds to the thickness of

the web so as to match the penetration power of the emitter to the difficulty of penetrating the material.

The pulses preferably are pulse-width modulated to enable the control of the duty cycle of the diode. The diode is driven at or near peak power to assure penetration of the web material where the perforations are imperfect and do not extend all the way through the web. The duty cycle of the diode is controlled to prevent damage to the diode, and also to reduce the intensity of the radiation when fully open perforations are detected and the amount of radiation reaching the detector otherwise would drive the detector into saturation.

The invention also provides a ticket dispensing machine using perforation detection means described above and ticket separation means actuated by the perforation detection means.

The ticket dispenser preferably dispenses tickets from several different supplies through several different outlet openings, thereby dispensing tickets of several different types from a single machine. The dispenser preferably has a single severing mechanism which will sever tickets from each of a plurality of supplies simultaneously - with a single stroke.

The perforation detector is made to serve a dual purpose by being used as an edge detector as well as a perforation detector. Preferably, after the separation mechanism has operated, the ticket panel is withdrawn until the detector detects the leading edge. Thus, the perforation detector provides a starting point for the leading edge in each dispensing operation, and withdraws the leading edge to a safe resting position inside the machine.

Preferably, the distances between adjacent perforation detections is used to set the width measurement of tickets being dispensed.

When perforations are not detected, the separator mechanism operates at the required time anyway.

After a missed perforation, and at regular intervals, even if no perforations are missed, the machine adjusts the detector emitter power levels and re-calculates the ticket widths to adjust for any changes which have occurred in the perforations and/or tickets.

The perforation detector is capable of detecting even the perforations which do not make an opening all the way through the web. Thus, it is a very accurate and reliable detector.

The reliability and accuracy of the device is further enhanced by the use of infra-red radiation because ambient visible light does not create unwanted interference and false readings.

The ticket dispenser is extremely compact, simple and inexpensive to make.

Embodiments of the invention will be described in detail hereinafter, with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of perforation detection means constructed in accordance with the invention;

Fig. 2 is a front elevation view of a lottery ticket dispenser constructed in accordance with the invention;

Fig. 3 is a rear perspective view of the dispenser of Fig. 2;

Fig. 4 is an enlarged cross-sectional view through two adjacent perforation detection devices in the dispenser of Figs. 2 and 3;

Fig. 5 is a perspective, partially schematic view of another embodiment of the perforation detector of the invention;

Fig. 6 is a side-elevation, partially cross-sectional view of a lottery ticket vending machine

constructed in accordance with the invention and incorporating the ticket dispenser of Figures 3 and 4;

Fig. 7 is a front elevation view of the vending machine of Fig. 6;

Figs. 8 and 10 are enlarged top plan views of portions of lottery ticket panels whose perforation lines are to be detected by use of the present invention;

Figs. 9 and 11 are cross-sectional views taken along lines 9-9 and 11-11 of Figures 8 and 10, respectively;

Figs. 12 and 13 are schematic electrical circuit diagrams for the perforation detector and the vending machine, respectively; and

Fig. 14 is a rear elevation view of a portion of the dispenser of Figs. 2-4, 6 and 7.

PERFORATION DETECTOR

The perforation detector of this invention is intended to be used with and/or within other apparatus, which would normally include means to move the web. In a ticket dispenser, this involves the advancement of a predetermined number of sheets or panels of tickets.

Thus, the perforation detector be incorporated in the lottery ticket dispenser of Figs. 2 and 3, a spreadsheet computer paper handling machine such as a printer, or similar equipment.

Fig. 1 shows a perforation detection device 10 which includes an infra-red transmitter 12 and receiver 14, located, in use, near a web 16 of material, the transmitter/receiver being driven by high-frequency pulses, which, coupled with voltage modulation (pulse with modulation), ensures a high degree of reliability and accuracy in perforation detection.

In fact, the method and apparatus of this invention is able to differentiate between perforations, including incomplete perforations, and surface irregularities such as those found in corrugated board stock, and is not influenced by external ambient light.

The transmitter 12 and receiver 14 are mounted in a generally c-shaped housing 18, such that the transmitter and receiver are on opposite sides of web 16, which moves in the direction of the arrow.

The web 16 has a plurality of lines 20 of perforations to be detected. The web 16 shown is a panel of lottery tickets separated from one another by the perforation lines 20.

Perforations 20 are detected by device 10, which is connected by wiring 22 to a high frequency detection printed circuit board (PCB) 24.

PCB 24 includes power terminals 26 and a serial line interface 28 to connect it to a CPU (See Figs. 12 and 13), and its circuitry 25 enables perforation detection and automatic adjustment of web parameters to occur, as it will be explained below.

The material which may be used in the web 16 are paper, cardboard or card material and thin plastics material in roll or fan-folded form. The material used in lottery tickets will be described in detail below.

During transition or movement past the detection system 10 of this invention, the device looks for perforation(s) 20 proper as an example of a change of state.

This carried out as follows. The infra-red emission from transmitter 12 is modulated at a selected, predetermined frequency by supplying the transmitter with high-frequency electrical pulses. When infra-red energy above a certain minimum level is detected by receiver 14, this is taken to mean that perforations 20 have been detected, and that enables the web to be stopped and/or a separator to be operated so that the web is separated along the line of perforations 20.

Referring now to Fig. 12, the transmitter/receiver unit comprising the body 18 and the transmitter 12 and receiver 14 mounted in opposite arms of the body, is a commercially available "slotted opto

switch" such as the Harris Model H22A4 switch. The transmitter 12 is a radiation-emitting diode 126 which produces radiation in the infra-red portion of the electromagnetic spectrum and little or no radiation in the visible portion of the spectrum. The receiver is a transistor 128 which is responsive to the infra-red radiation of the transmitter. Since the receiver does not respond to visible light, the detector is essentially immune to interference and false detection due to ambient light.

The diode 126 is driven by a square-wave pulse generator 124 which produces D.C. pulses V as shown in Fig. 12. The amplitude of the pulses preferably equals or exceeds the rated voltage of the diode so as to ensure that the maximum power for penetrating the web 16 at the locations of the perforations 20 where they do not extend all of the way through the web. However, the power delivered to the diode is kept below the level which will cause the diode to burn out by the use of pulses which reduce the duty-cycle of the diode to a safe level.

Variation of the pulse repetition rate can be used to change the penetration capability of the infra-red beam from the transmitter. It has been discovered that, in general, the penetration capability increases as a function of the pulse repetition rate or frequency. For example, for penetrating relatively thick cardboard stock on which lottery tickets of the scratch-off instant winner type are printed, a repitition rate of 55 KHz has been found to be beneficial . Rates below 10 KHz have are believed to be beneficial for detecting perforations in thinner stock such as paper.

It is believed that this effect is due to a narrowing of the beam of radiation emitted by the transmitter as the repitition rate increases. It is believed that this is due to the interaction of the diode 126 with the lens (not shown) which is used to focus the beam. Narrowing the beam is believed to increase the

radiation density per unit area and thus increase the ability of the beam to penetrate materials.

In accordance with another feature of the invention, the width of the pulses is modulated by a pulse-width modulation circuit 122 controlled by the microprocessor CPU 120 in accordance with feedback signals from a motor drive circuit 130.

Figs. 8 and 9 show two types of perforations found in lottery tickets. As it is shown in Fig. 9, a completely open hole 116 is formed in the web 16. The web comprises a relatively thick cardboard base with a thin, uniform metallic coating 112 and a layer of printing ink 114 and other coating materials on top of the coating 112. In an alternative construction, there is simply a coating of metallic ink on the surface of the cardboard.

The transmitter diode normally is operated at maximum permissible power. When open holes such as the hole 116 are detected, the power level transmitted to the receiver is so high that it tends to drive the receiver into saturation so that its output does not return to zero between voltage pulses. This circumstance is detected by level detector means in the circuit 130, and signals are sent back to the CPU 120 to indicate a need for reduction of power. The CPU causes the pulse-width modulation circuit 122 to reduce the width of the pulses until saturation no longer occurs. This process normally is performed when a new batch of tickets is loaded into the ticket dispenser using the perforation detector, but also is performed whenever the saturation condition is detected and at regular time intervals during operation.

The perforation detector has the ability to detect even imperfect perforations such as those illustrated in Figs. 10 and 11, in which the perforation only forms a dent 118 in the material and does not extend all the way through the web material. For detection of such perforations, the power level of the radiation is

set at or near the maximum by the pulse-width modulation circuit 122. Thus, the perforation detector will detect essentially every perforation in which at least the metallic coating 112 on the web is broken. This ensures a very high level of accuracy and reliability in detecting even the poorly-formed perforations so often found in lottery ticket and other ticket perforations.

When perforations are detected, they are used to drive a motor 96 which is used, in a ticket dispenser, to separate one or more tickets from the others in a ticket panel, as it will be explained in greater detail below.

It is believed that other emitters of non-visible radiation such as laser diodes also can be used as emitters in the invention.

It is envisaged that the use of the detector may be with lottery tickets, continuous fan-folded instant 'scratch' tickets or pull-tab tickets.

Also, it may be used in relation to computer paper, for separation of spreadsheets and pre-perforated paper.

The device also can be used for transit ticket dispensers, for streetcars, tram, bus, and train tickets, and on production lines for packaging materials or media printing.

TICKET DISPENSER

Figs. 2 to 4 show a lottery ticket dispenser 30 utilizing the perforation detector of the invention.

The front 48 of dispenser 30 has four slots 32, 34, 36 and 38 each corresponding to one of the game selection push-buttons 30, 42, 44 and 46.

Behind the front 48 of dispenser 30 (Fig. 3) is a transport arrangement 50, which includes four sets of rollers 52, one for each slot (32, 34, 36, 38). Each set of rollers 52 is driven by separate drive motor (not shown in figs. 2 to 4). A fifth drive motor (not shown in Figs. 2 to 4) operates a blade (not shown in Figs. 2

to 4) which separates tickets, after a predetermined number of tickets have been advanced, along a line of perforations 20, after detection by the device 10.

TICKET VENDING MACHINE

Figs. 6 and 7 show a lottery ticket vending machine 66 using the ticket dispenser 30 to dispense lottery tickets from each of four separate supplies.

The machine 66 includes a housing 68 with an arcuate cover 70 made of strong, break-resistant transparent material such as Lexan which can be locked in place and removed only by authorized personnel.

Four separate panels of tickets 76, 78, 84 and 86 are stored on trays or shelves 72 and 74. The tickets are shown in dashed outline in Fig. 7 for the sake of clarity.

As it is shown in Fig. 6, the tickets 78 for Game 3 pass over an upper idler roller 80 and downwardly toward the outlet slot 36. The tickets 84 for Game 4, which are not visible in Fig. 6, similarly pass over the roller 80 and downwardly toward the outlet slot 38.

The tickets 76 for Game 1 pass over a lower idler roller 82 and downwardly towards the outlet slot 32, and the tickets 86 for Game 2 pass over the roller 82 and downwardly toward outlet slot 34. The tickets 86 also are not visible in Fig. 6.

By passing upwardly from the fan-fold stacks of panels, the tickets are visible to the purchaser through the transparent cover 70 as they move in the housing, this stimulating interest and encouraging purchases.

Each string of tickets is pulled from one of the stacks by one of the four sets of drive rollers 52 driven by one of four drive motors 88, only two of which are visible in Fig. 6. Each drive motor is reversible and is geared to the drive rollers.

One of perforation detectors 10 is located in the path along which each string of tickets moves to detect perforations. The tickets pass through the rolls

52, past the detector 10, and between a set of four guide blocks 90. A single separator blade 92 is driven upwardly and downwardly by a drive motor 96 which drives a pair of drive gears or pinions 98 mating with racks 94.

Fig. 14 shows the blade 92, without supporting (for clarity), and the racks 94. The blade 92 is shown in solid lines in its neutral or rest position, where it is poised to move either upwardly to separate tickets extending through slot 32 or 38 or downwardly to separate tickets extending through slot 36 or 34.

The blade 92 has a basically rectangular shape with four edges 91, 93, 97 and 99 sloping upwardly or downwardly at an acute angle θ with respect to the planes of the ticket panels passing through the outlet slots 32, 34, 36 or 38. The preferred angle θ is a approximately seven degrees. This ensures that the ticket separating motion of the blade will start the tear at one edge of the perforation line to facilitate the separation process.

The position of the blade 92 at the end of an upward separating stroke is shown by dashed lines 91', 93', 97' and 99'. The upper edges 91' and 93' have moved past the slots 32 and 34. The blade then moves downwardly past the slots 36 and 38 to separate tickets extending through either of those slots.

The separating edges 91, 93, 97 and 99 are blunt so that they tear the tickets apart rather than cutting them. When the blade moves upwardly or downwardly, it forces the tickets against the blocks 90 and the blade moves into the space between adjacent blocks. The blocks 90 thus hold the tickets to permit the blade to pass through them at the perforation line.

The customer then can grasp the ticket or string of tickets cut off. A receptacle (not shown), can be provided, if desired, to catch the tickets to keep them from falling out of the machine.

As it is shown in Fig. 7, a money acceptor 102 is provided into which bills can be inserted to pay for the tickets to be dispensed. A display 100 is provided to display amount credit the customer has. The number of tickets ordered can be input by means of a keypad 132. It is preferred that each of the four supplies contains tickets of a different game. The game can be selected by pressing one of the four buttons marked "Game 1", "Game 2", etc.

Fig. 4 shows adjacent perforation detectors 10 in a lottery ticket dispenser of the type shown in Figs. 2, 6 and 7. A wall 104 separates the detectors from one another.

Fig. 5 shows an alternative arrangement of detectors for a web 16 of tickets. Three detectors 10, 10 and 61 are provided for detecting each perforation in a strip of tickets. The detector 61 comprises a transmitter 62 like the transmitter 12 and a receiver 64 like the receiver 14. The transmitter and receiver are separated from one another and mounted on separate supporting structures (not shown).

Two or more detectors are used instead of just one to ensure detecting perforation lines in which the perforations may be so poor that they are not detectable at one edge of the strip, but are detectable at the other edge or elsewhere. The output of the detectors can be connected to an OR gate (not shown) to provide a detection signal if any one of the detectors detects a perforation.

CONTROL CIRCUIT

Fig. 13 is a schematic diagram of the control circuit of the vending machine of Figures 6, 7 and 14.

The circuit includes a microprocessor with a CPU 120 and memory (not shown), the money acceptor 102, which is of conventional construction, the key pad 132 for entry of ticket ordering information, a service key pad 142 and a printer 140 located inside the vending

machine for use by service personnel, the push buttons 40, 42, 44 and 46, and the credit display 100.

The four ticket drive motors are indicated at 138. Each has a shaft-position encoder to indicate the position of its shaft. The encoders are shown schematically at 134.

The perforation detection control circuit 25 is shown delivering signals to the separation 96 and to the CPU to control separation of the tickets.

A modem 136 can be provided to connect the machine to a central computer for centralized monitoring and control.

TICKET WIDTH DETERMINATION

The dispenser of the invention automatically adjusts itself for dispensing tickets of varying widths, and uses an automatic self-diagnostic routine to make any adjustments needed during operation.

When a new batch of tickets is loaded into the machine 66, the tickets are fed forwardly in the direction of the arrow in Fig. 1 by the rollers 52 until the leading edge of the first ticket breaks the beam of the transmitter 12, and the tickets stop to wait for the first customer. The width of the tickets is equal to the distance between perforations, and, for lottery tickets, usually is smaller than the length.

When the customer places the first order for tickets from a given dispenser, the tickets are advanced relatively slowly until the first perforation line 20 is detected. The starting position of the shaft position encoder is stored, as is the position at which the first perforation line is detected. The difference between the counts of the encoder at each location is stored in memory as a first measurement of the ticket width.

The lead ticket is driven forward by a distance equal to the distance from the detector 10 to the blade 92. If it is the only ticket ordered, the blade 92 is driven quickly to separate the ticket from the remainder.

After the ticket is separated, the ticket drive motor reverses and backs up the ticket string until the detector 10 detects the leading edge of the ticket and the tickets stop, with the ticket edge just barely blocking the radiation.

If the initial order was for more than one ticket, the blade 92 does not operate, and the tickets continue to move forwardly until the next perforation line is detected. The width of the second ticket also is stored in memory, as was the width of the first ticket.

This process continues until three ticket width measurements have been stored in memory. Then the microprocessor computes the average of the three widths and stores that as the standard ticket width.

Thereafter, if a perforation line has not beem detected within a very short distance (e.g., fifty thousandths of an inch) of where it should be, the machine will create a detection signal and, if severance should be made, direct the blade drive motor to sever the tickets at the location where the perforation line should be.

SELF-DIAGNOSTIC ROUTINES

If a perforation line was not detected where it should have been, then the routine described above is repeated; that is, the average of three ticket widths is determined, etc., to adjust for any variations which may have occurred.

As a further part of the self-diagnostic routine, if a line of perforations is not detected when it should have been, the pulse-width modulation circuit increases the widths of the pulses driving the diode 126 to the maximum, and then reduces the width, if necessary, to prevent saturation of the transistor 128, thus ensuring that the infra-red beam is at an intensity level sufficient to penetrate the material of the tickets even when the perforations are incomplete, as shown in Fig. 11. It is preferred that these self-diagnostic routines

be performed periodically, even when no perforations are missed.

It can be seem that this invention provides an improved perforation detection method and apparatus.

The detector is insensitive to ambient light, and thus avoids errors from that source. Nonetheless, it is sensitive enough to detect grossly imperfect perforations, even those which do not create a hole through the material of the web.

Despite the sensitivity, resistance to false indications, accuracy and reliability, the perforation detector is relatively simple and inexpensive to make and use, and is very compact.

The ticket dispenser and vending machine of the invention provide similar advantages, especially when dispensing lottery tickets, whose perforations are of highly variable quality.

The dispenser is especially compact and simple, in part because it uses a single reciprocating blade to separate the tickets from one another in each of a plurality of different dispensers in a single housing.

Moreover, by using the perforation detector to detect the leading edge of the ticket string, as well as the perforation lines, and returning the leading edge to the perforation detector after dispensing tickets, the detector is made to do double duty. This saves cost. Also, the leading edge of the ticket string is withdrawn away from the outlet slot where it might be grasped and pulled out of the machine by one who has not paid for the tickets.

The automatic self-diagnostic routines performed by the dispenser offer both fail-safe operation and automatic adjustment of the detector to compensate for changes in the perforations or tickets, to further enhance the reliability of the dispenser.

Since modifications within the spirit and scope of the invention may be readily effected by persons

skilled in the art, it is to be understood that the invention is not limited to the particular embodiments described, by way of example, hereinabove.

CLAIMS

1. A perforation detection method for detecting perforations forming lines delineating separate panels from one another in sheet material, said method comprising the steps of: providing an emitter of radiation with a frequency predominantly outside of the visible light portion of the electromagnetic spectrum, directing said radiation towards said perforations, utilizing a detector for detecting said radiation as modified by said perforations, and producing corresponding detection signals.

2. A method as in Claim 1 in which said radiation is predominantly infra-red radiation.

3. A method as in Claim 1 including the step of energizing said emitter with electrical energy, and setting the energy delivered to said emitter to a level high enough to activate said detector when perforations of a depth less than the thickness of said sheet material are to be detected.

4. A method as in Claim 1 including driving said emitter with pulses at a repetition rate which is a direct function of the thickness of said sheet material.

5. A perforation detector for detecting perforations forming lines delineating separate panels from one another in sheet materials, said detector comprising, in combination, a radiation emitter emitting radiation having a wavelength predominantly outside of the visible light portion of the electromagnetic spectrum and directing said radiation towards at least one perforation in said sheet material, a detector for selectively detecting said radiation as modified by said perforation and developing a corresponding detection signal, and a source of electrical energy connected to deliver electrical energy to said emitter at a level which is a function of the size of the perforations being detected.

6. A detector as in Claim 5 in which said emitter is an infra-red emitter.

7. A detector as in Claim 5 in which said source includes control means for controlling the power delivered to said emitter and thereby controlling the energy emitted by said emitter, said control means including means for setting said power at a relatively high level, said detecting means being adapted for detecting the energy transmitted through said perforation, and means for reducing said power if the energy detected exceeds a predetermined level.

8. A device for separating panels delineated from one another in sheet material by lines of perforations, said device comprising a detector for detecting perforations in said sheet material, said detector comprising, in combination, an infra-red radiation emitter for emitting and directing infra-red radiation toward said perforations in said sheet material, an infra-red radiation detector for detecting infra-red radiation as modified by said perforations and producing a corresponding detection signal, and a separator responsive to said detection signal for separating one of said panels from said sheet material along one of said perforation lines.

9. A method of dispensing flat articles from panels with perforation lines delineating said articles from one another, said method comprising the steps of: utilizing at least one drive source for feeding said panels, providing an infra-red perforation detector, utilizing a separator device responsive to signals from said detector for separating said articles from one another along said perforation lines, and utilizing said detector to detect the leading edge of a panel.

10. A ticket dispenser for dispensing tickets from panels of tickets delineated from one another by lines of perforations, said dispenser comprising, in combination, a housing having a plurality of outlet

openings, a drive system for feeding each of a plurality of different ones of said ticket panels towards a selected one of said outlet openings, a perforation detector for detecting the perforation lines in each of said panels and producing corresponding detection signals, and a separating device responsive to said detection signals for separating one or more tickets from the others in each of a plurality of said panels, and dispensing the severed ticket or tickets through one of said outlet openings.

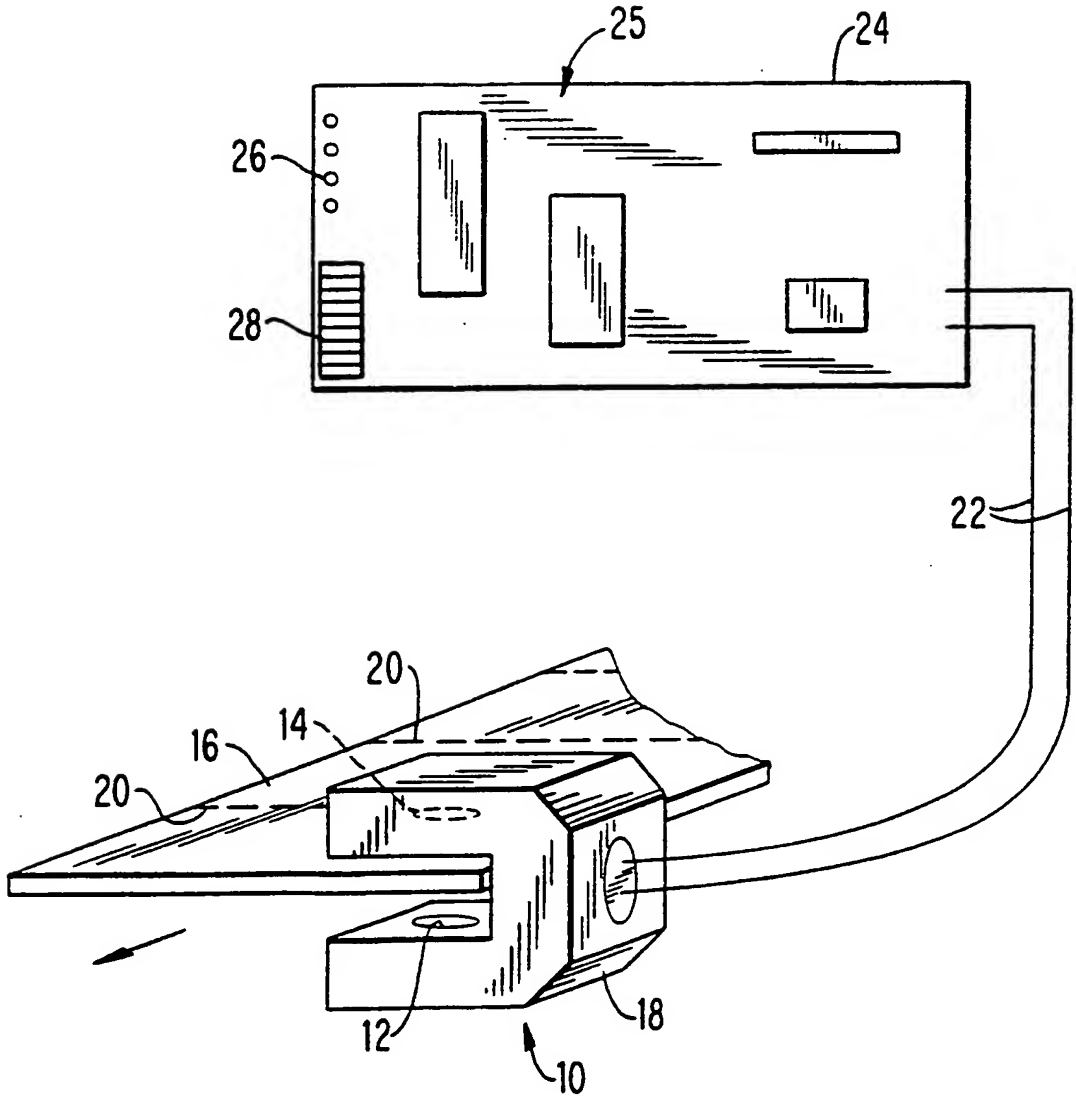


FIG. 1

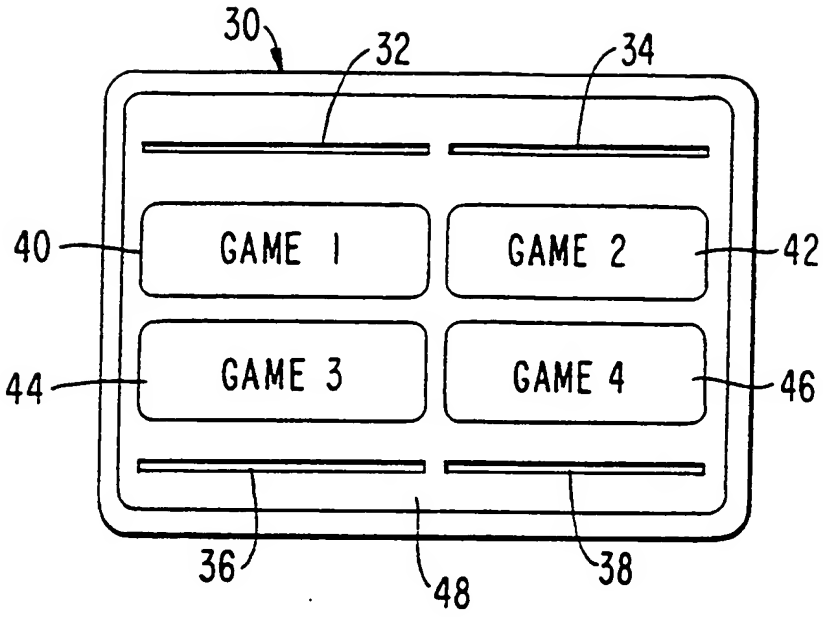


FIG. 2

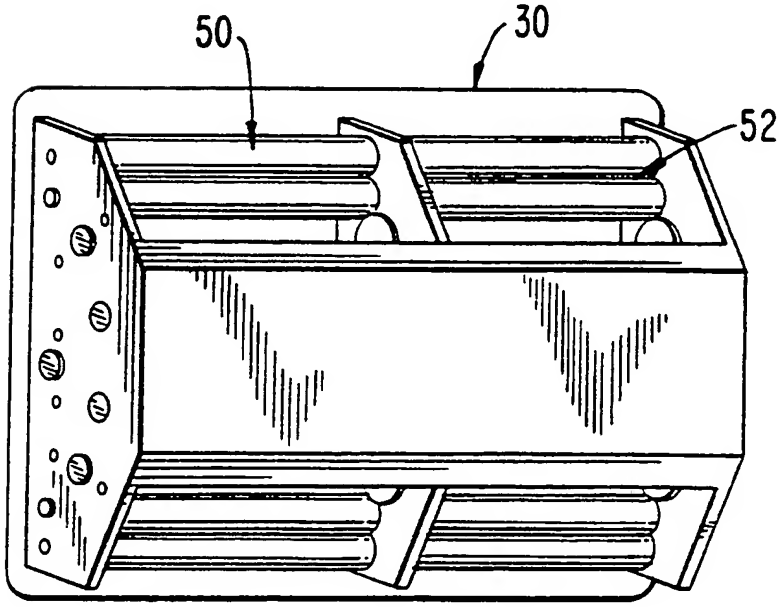


FIG. 3

FIG. 4

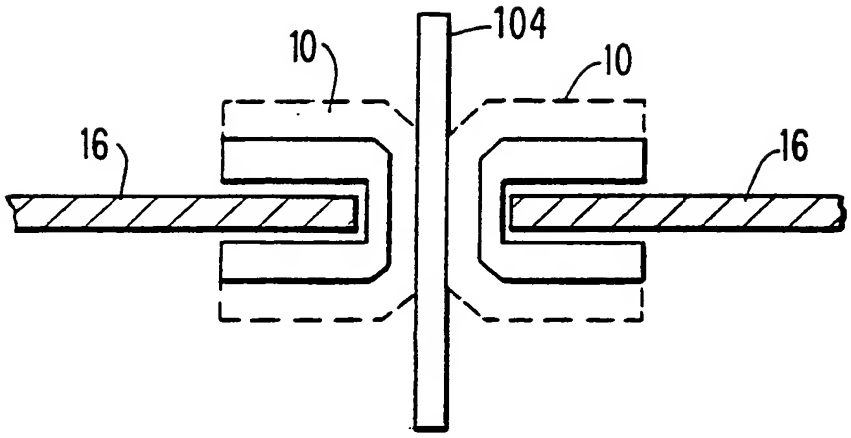
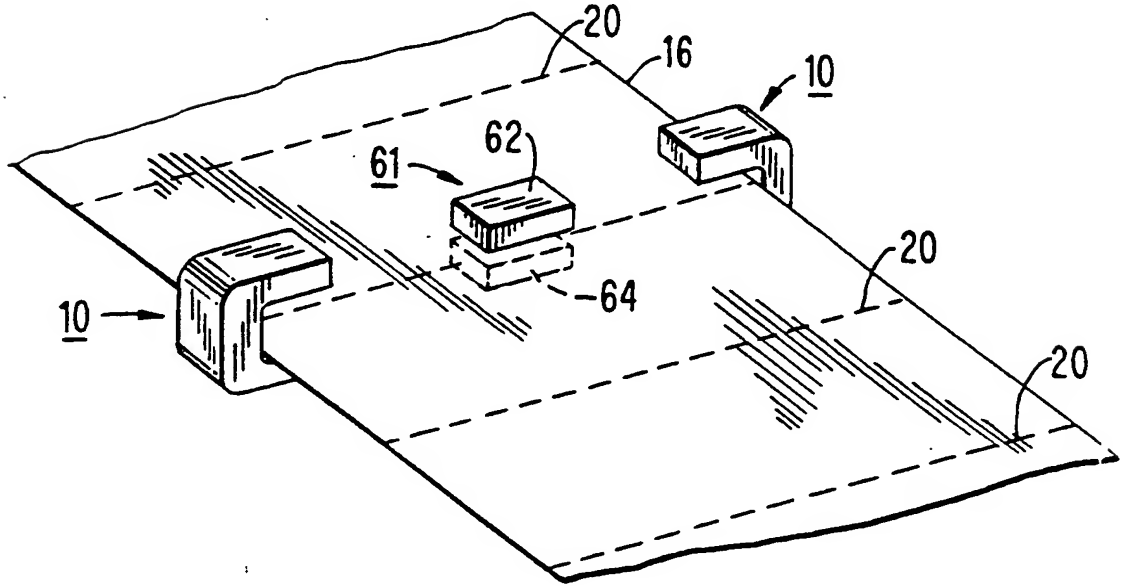


FIG. 5



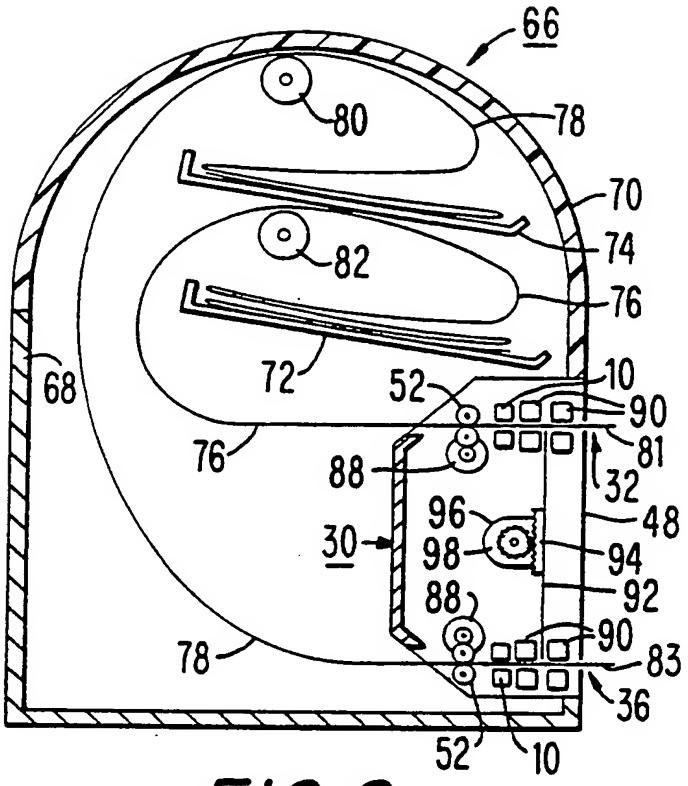


FIG. 6

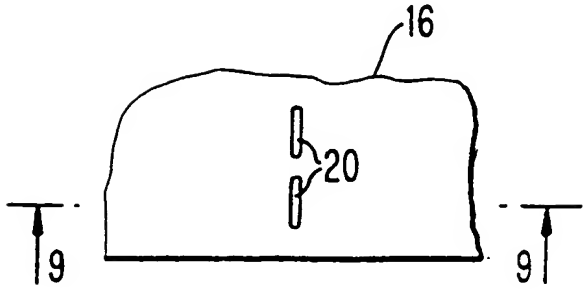


FIG. 8

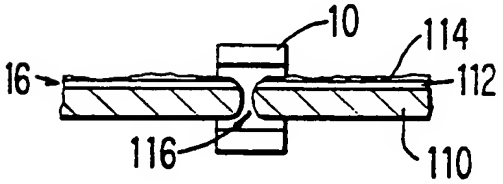


FIG. 9

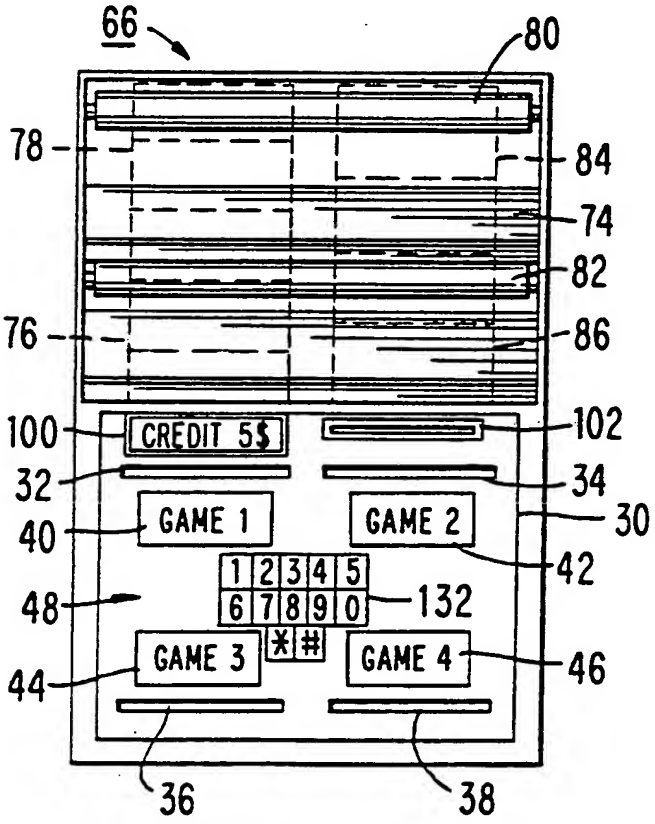


FIG. 7

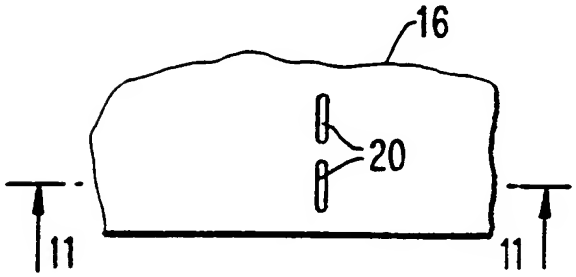


FIG. 10

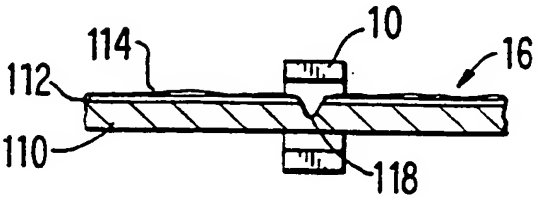


FIG. 11

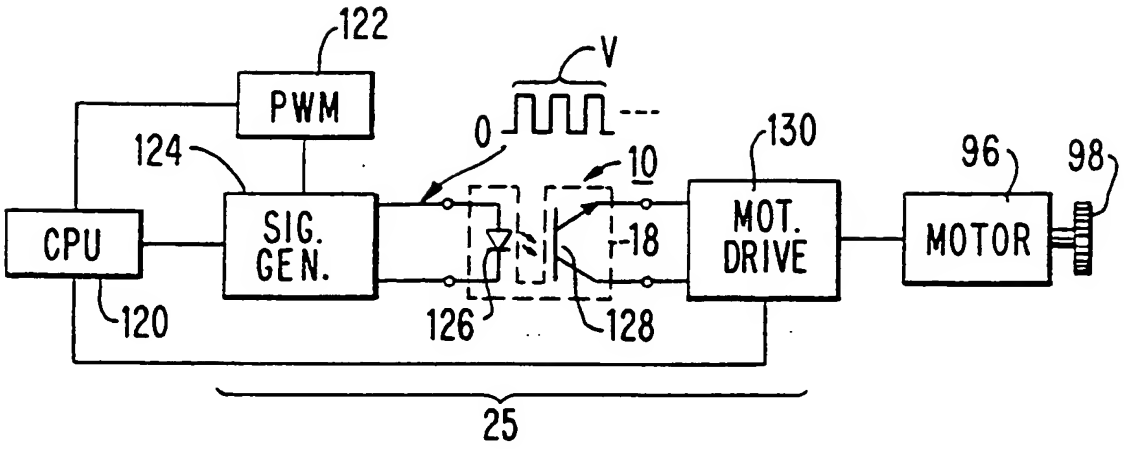

122
PWM
V
0
124
10
130
96
98
CPU
SIG. GEN.
18
MOT. DRIVE
MOTOR
120
126
128
25

FIG. 12

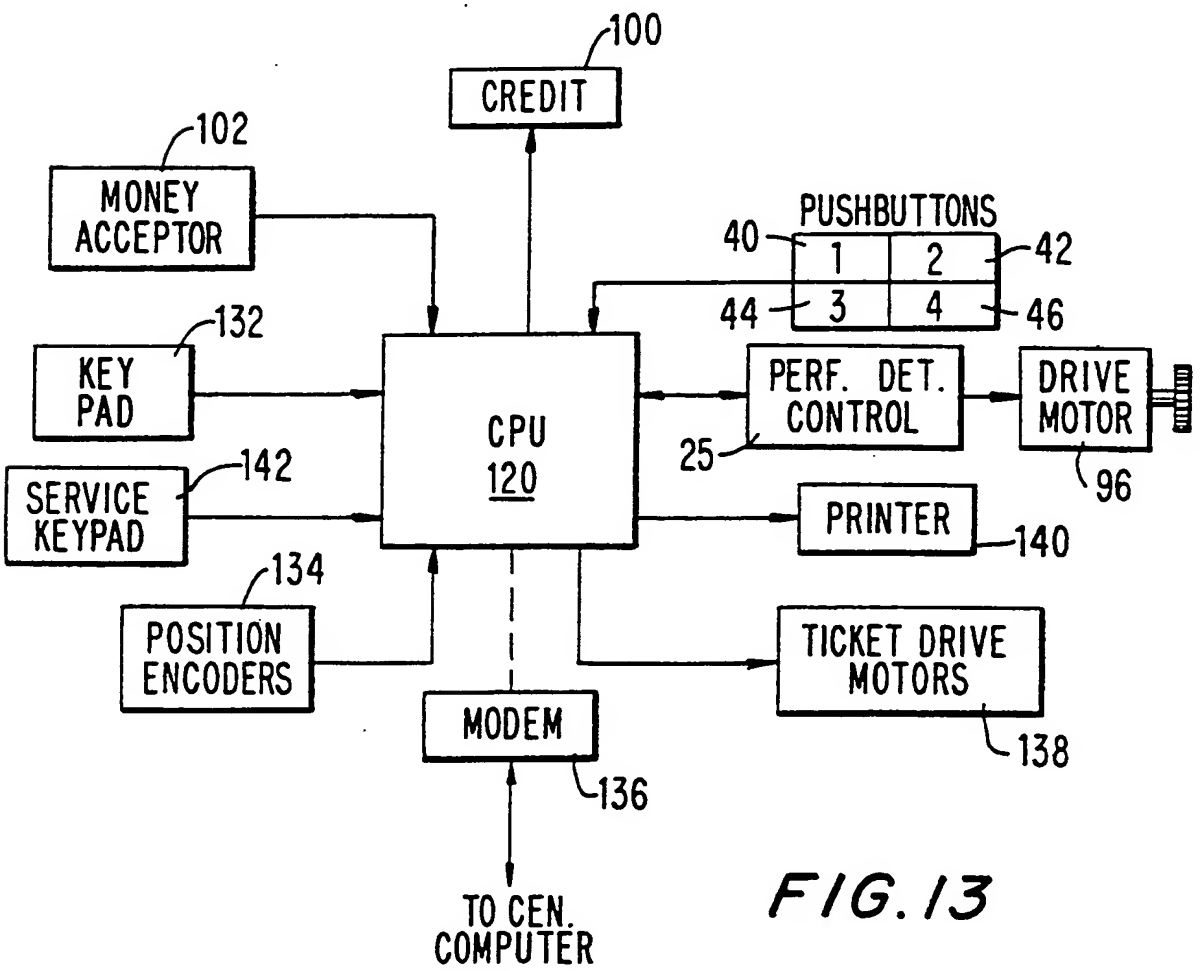

100
CREDIT
102
MONEY ACCEPTOR
PUSHBUTTONS
40
1
2
42
44
3
4
46
132
KEY PAD
CPU 120
PERF. DET. CONTROL
DRIVE MOTOR
25
96
142
SERVICE KEYPAD
PRINTER
140
134
POSITION ENCODERS
TICKET DRIVE MOTORS
138
MODEM
136
TO CEN. COMPUTER

FIG. 13

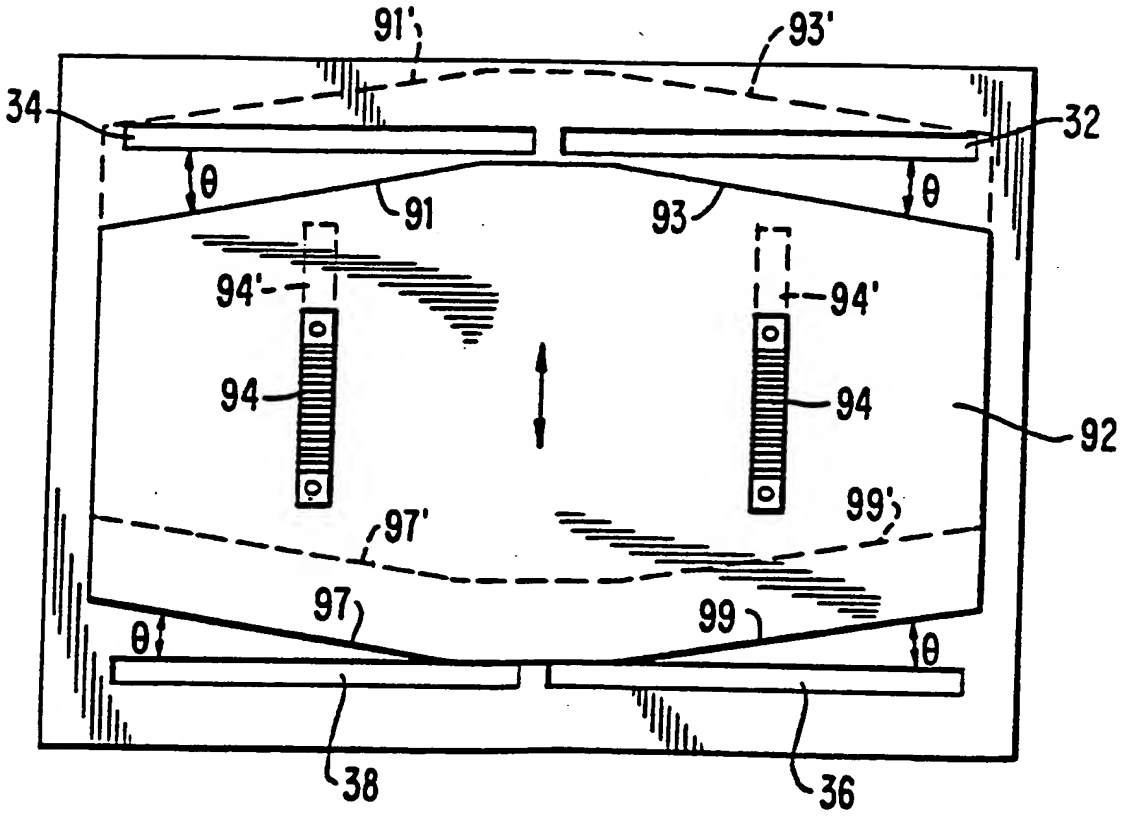


FIG. 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/10430

A. CLASSIFICATION OF SUBJECT MATTER
IPC(5) :B26D 3/00; G01V 9/04; A63B 71/00
US CL :250/341, 354.1, 571, 222.1; 225/103; 83/209, 243, 365, 369
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 225/104, 105; 83/360,367, 103; 250/341,354.1,571,222.1; 83/209,243,365,369

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Please See Extra Sheet.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US,A 3,557,380 (MATTHEWS) 19 January 1971 see entire document	1-9
Y	US,A 3,621,962 (RIDDLE et al) 23 November 1971 see entire document	1-9
Y	US,A 4,335,316 (GLANZ et al) 15 June 1982 see entire document	1-9
Y	US,A 4,221,329 (SCHNEIDER) 09 September 1980 see entire document	1-9
Y	US,A 4,609,815 (HISHINUMA et al) 02 September 1986 see entire document	1-9

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search
21 DECEMBER 1993

Date of mailing of the international search report
06 JAN 1994

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231
Facsimile No. NOT APPLICABLE

Authorized officer
For DREW A. DUNN
Telephone No. (703) 308-0956

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/10430

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US,A 4,637,523 (LEVASSEUR) 20 January 1987 see entire document	1-9
Y	US,A 4,716,799 (HARTMANN) 05 January 1988 see entire document	1-9
Y	US,A 4,730,108 (RODAL et al) 08 March 1988 see entire document	1-9
Y	US,A 4,821,066 (FOOTE, JR. et al) 11 April 1989 see entire document	1-9
Y	US,A 4,982,337 (BURR et al) 01 January 1991 see entire document	1-9
Y	US,A 5,211,093 (HORMNIAK) 18 May 1993 see entire document	1-9
Y	US,A 3,552,616 (MASON) 05 January 1971 see entire document	10
Y	US,A 3,627,183 (MASON) 14 December 1971 see entire document	10
Y	US,A 4,094,451 (WESCOAT) 13 June 1978 see entire document	10
Y	US,A 5,215,383 (HILTON) 01 June 1993 see entire document	10

INTERNATIONAL SEARCH REPORT

Int. ational application No.
PCT/US93/10430

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
(Telephone Practice)
Please See Extra Sheet.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/10430

B. FIELDS SEARCHED
Electronic data bases consulted (Name of data base and where practicable terms used):

APS (Automated Patent System)
S Perforation? and Dispens?
S L1 and Detect? (10A) Perforation
S L2 and (Infrared or Infra(w)Red)
S L1 and Ticket? (w) Dispens?

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING
This ISA found multiple inventions as follows:

Detailed Reasons for Holding Lack of Unity of Invention:

Group I, claims 1-9, drawn to a perforation detection means utilizing radiation outside the visible spectrum, classified in Class 250, subclass 341.

Group II, claim 10, drawn to a ticket dispensing means with a separating means, classified in Class 225, subclass 103.

The claims of these two groups are directed to different inventions which are no so linked as to form a single general inventive concept. The inventions are not linked in operation and perform separate operations.